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407 955

EVALUATION OF NAVY INVENTORY DECISION RULES UTILIZING THE IBM INVENTORY MANAGEMENT SIMULATOR

FINAL REPORT
CONTRACT NONR 3742(00)

Flow Charts

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JUN 17 1963
TISIA B

IBM
FEDERAL SYSTEMS DIVISION
ROCKVILLE, MARYLAND

Evaluation of Navy Inventory Decision Rules
Utilizing the IBM Inventory Management Simulator

FINAL REPORT

CONTRACT NONR 3742(00)

29 June 1962

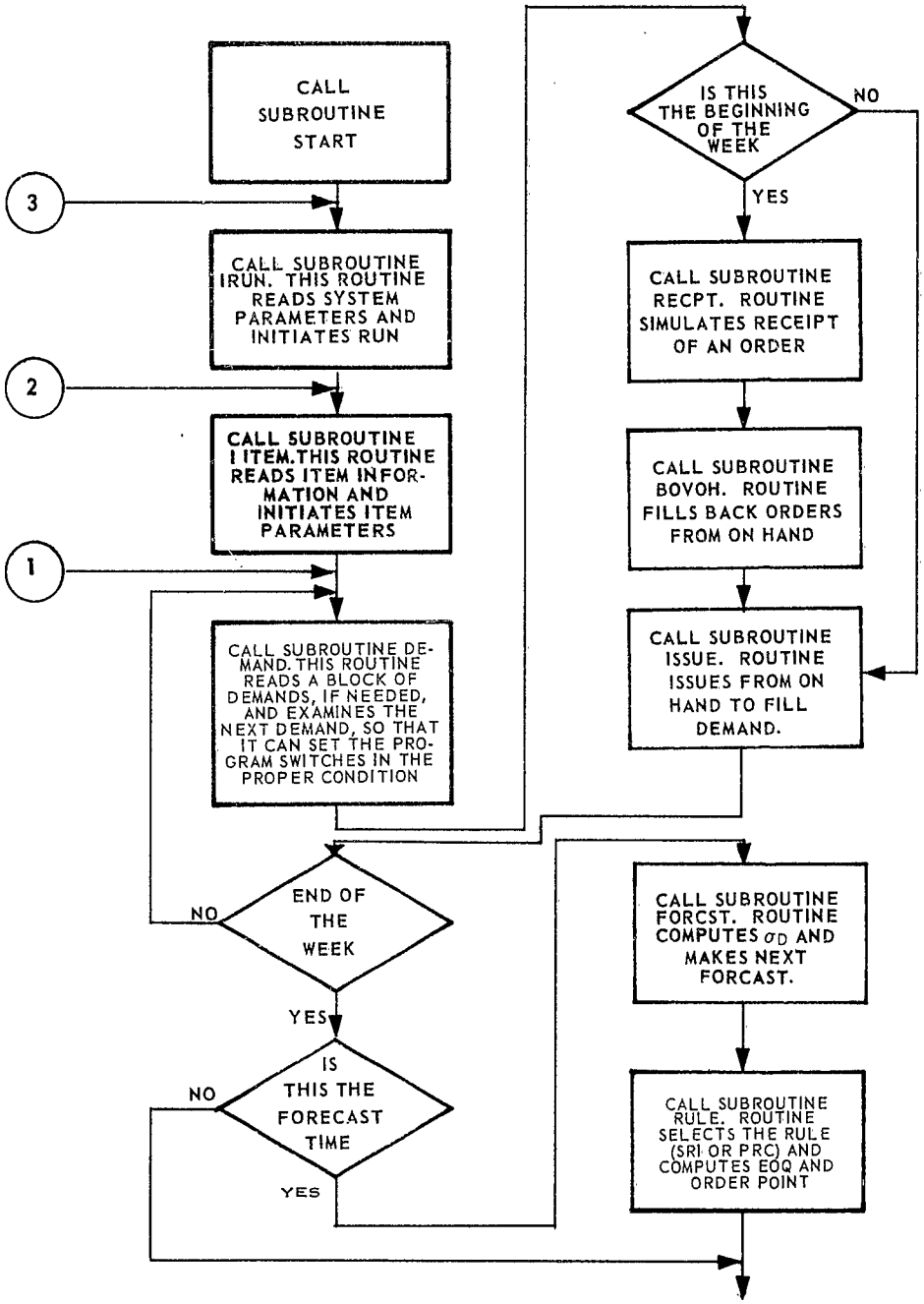
Submitted to

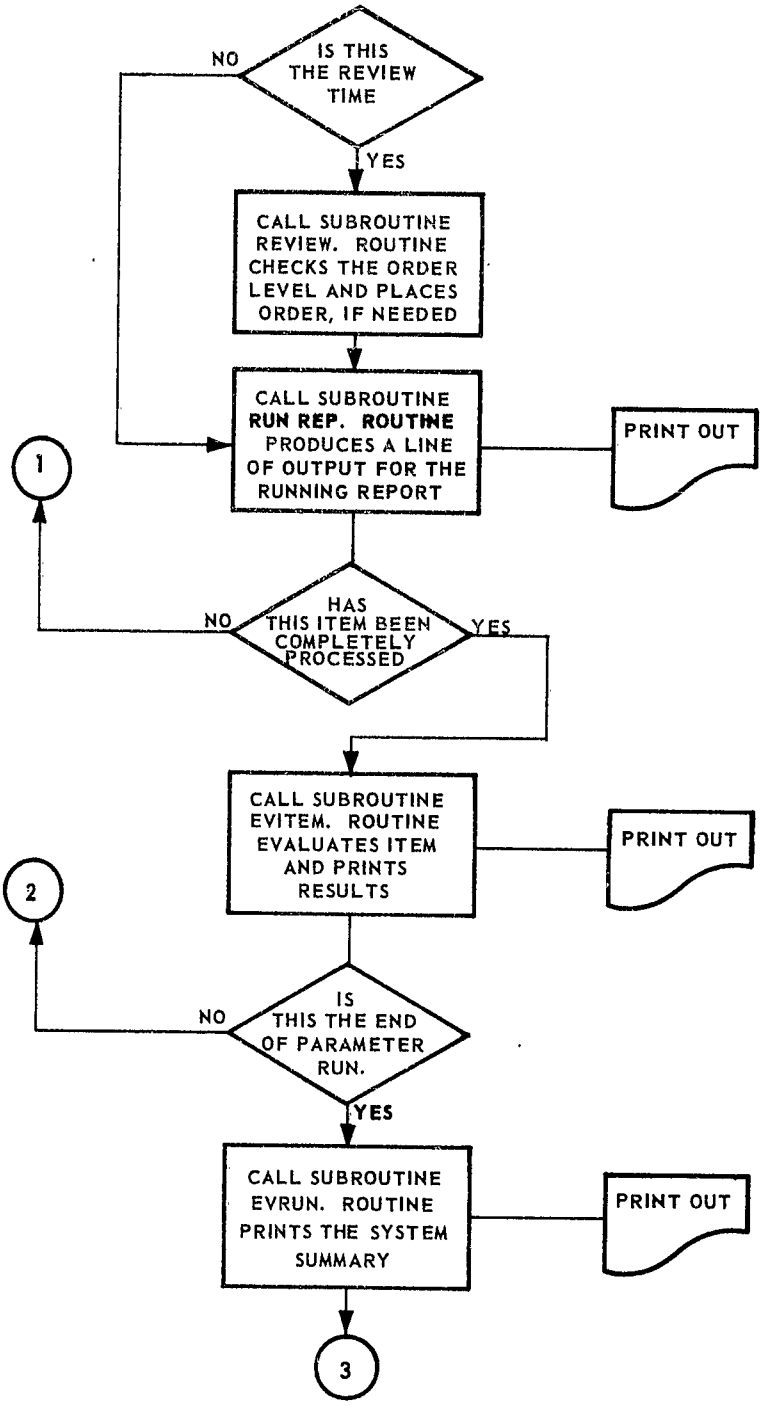
DEPARTMENT OF THE NAVY
Bureau of Supplies and Accounts
Advanced Logistics Research Division
Washington 25, D. C.

Flow Charts

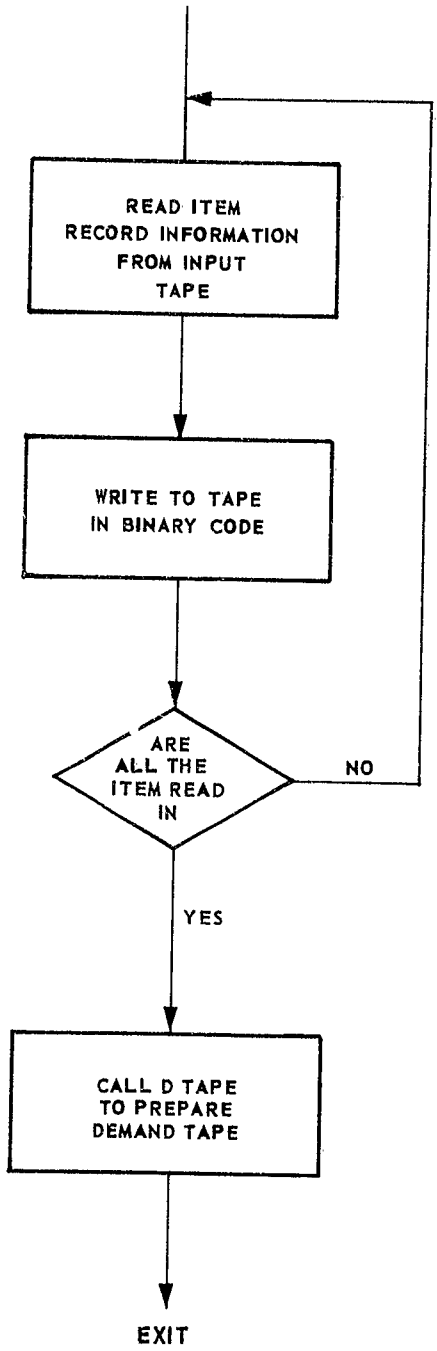
FEDERAL SYSTEMS DIVISION
INTERNATIONAL BUSINESS MACHINES CORPORATION
ROCKVILLE, MARYLAND

MAIN LINE PROGRAM
1 of 2

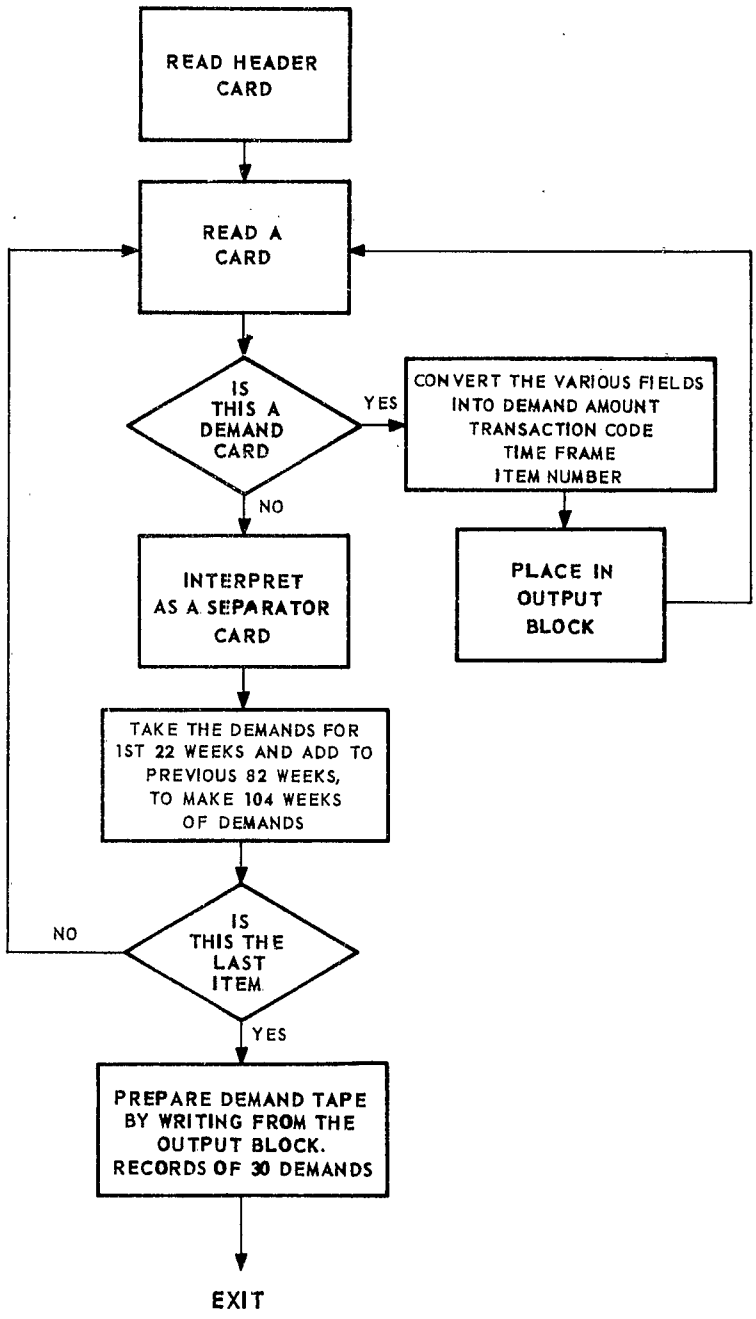



IS THIS THE REVIEW TIME
NO
YES
CALL SUBROUTINE REVIEW. ROUTINE CHECKS THE ORDER LEVEL AND PLACES ORDER, IF NEEDED
CALL SUBROUTINE RUN REP. ROUTINE PRODUCES A LINE OF OUTPUT FOR THE RUNNING REPORT
PRINT OUT
1
HAS THIS ITEM BEEN COMPLETELY PROCESSED
NO
YES
CALL SUBROUTINE EVITEM. ROUTINE EVALUATES ITEM AND PRINTS RESULTS
PRINT OUT
2
IS THIS THE END OF PARAMETER RUN.
NO
YES
CALL SUBROUTINE EVRUN. ROUTINE PRINTS THE SYSTEM SUMMARY
PRINT OUT
3

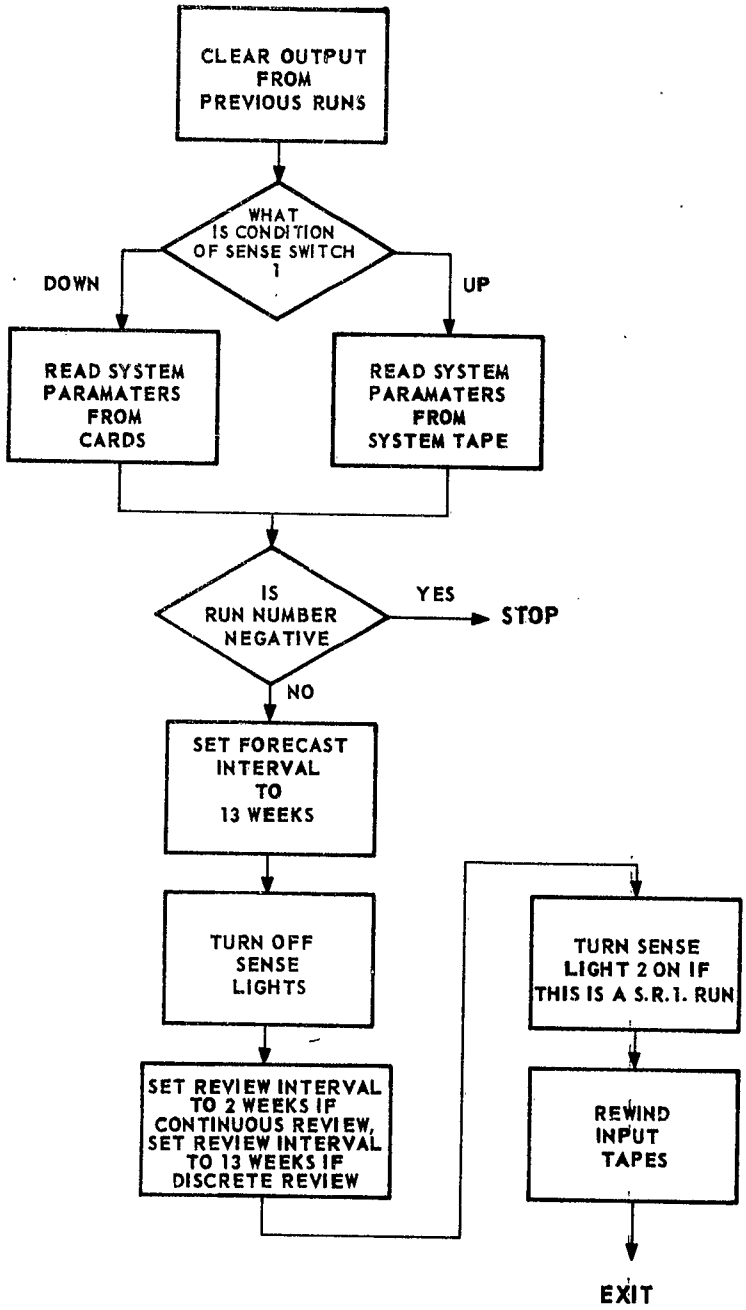
SUBROUTINE START



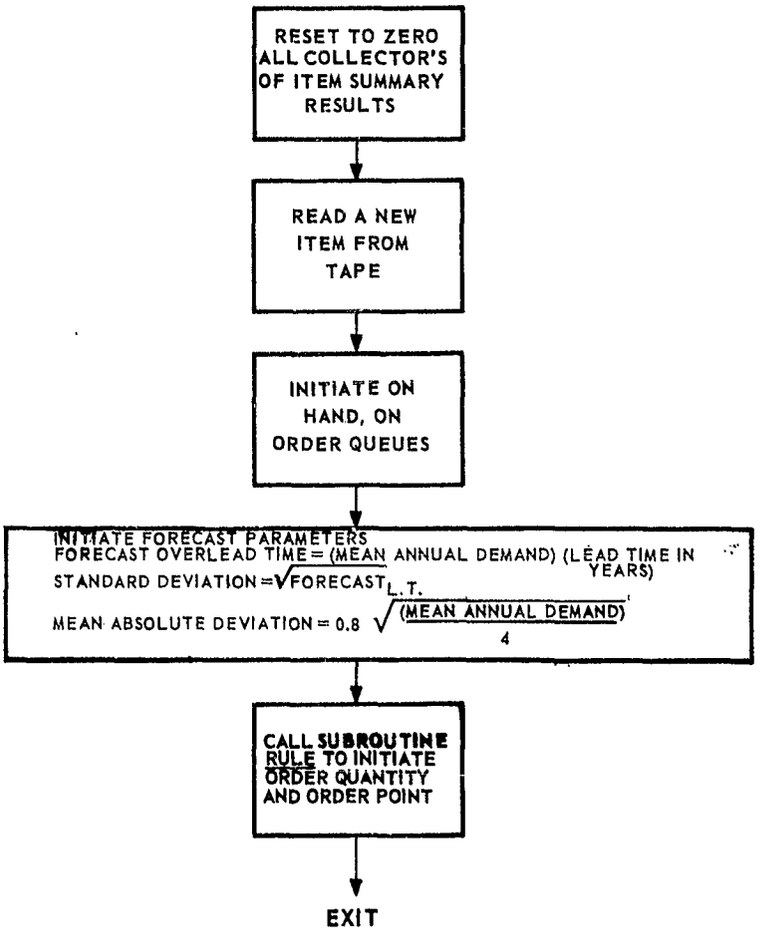
SUBROUTINE D TAPE
(PREPARE DEMAND TAPE)

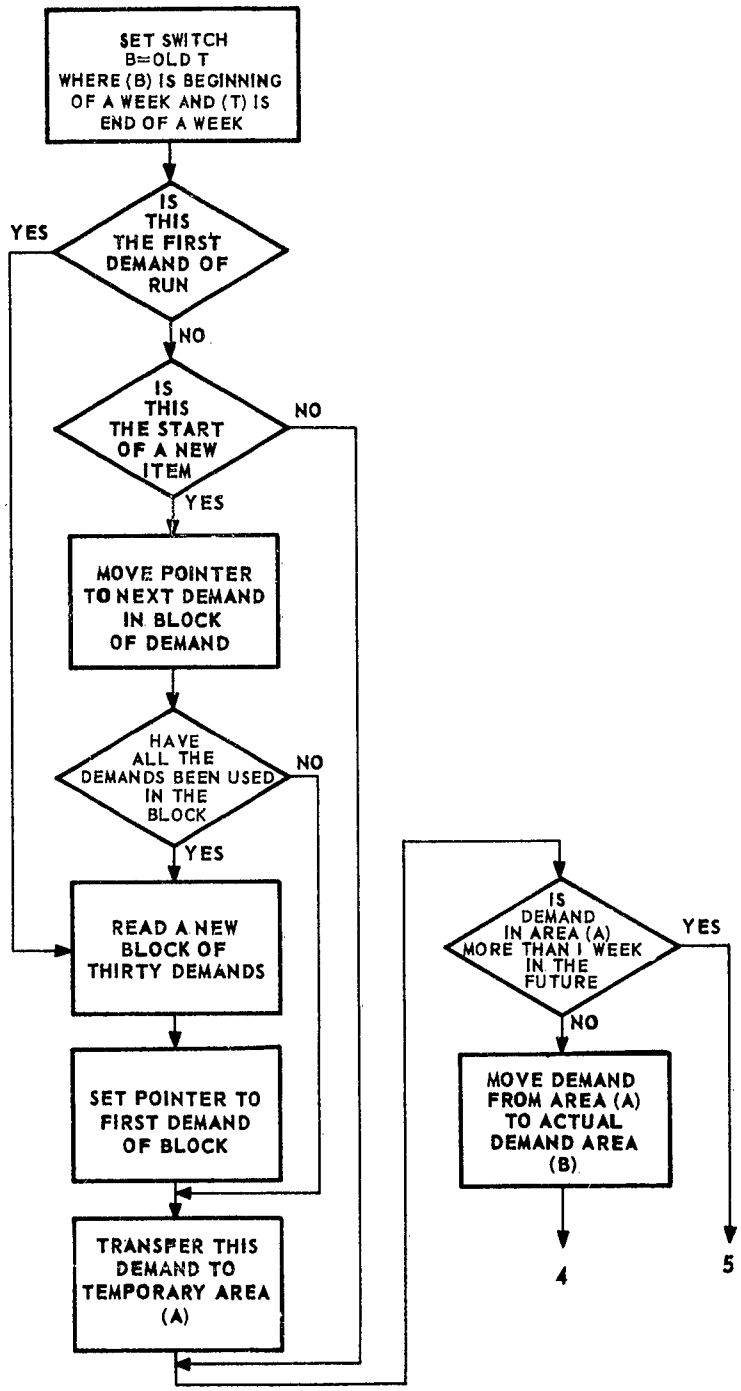


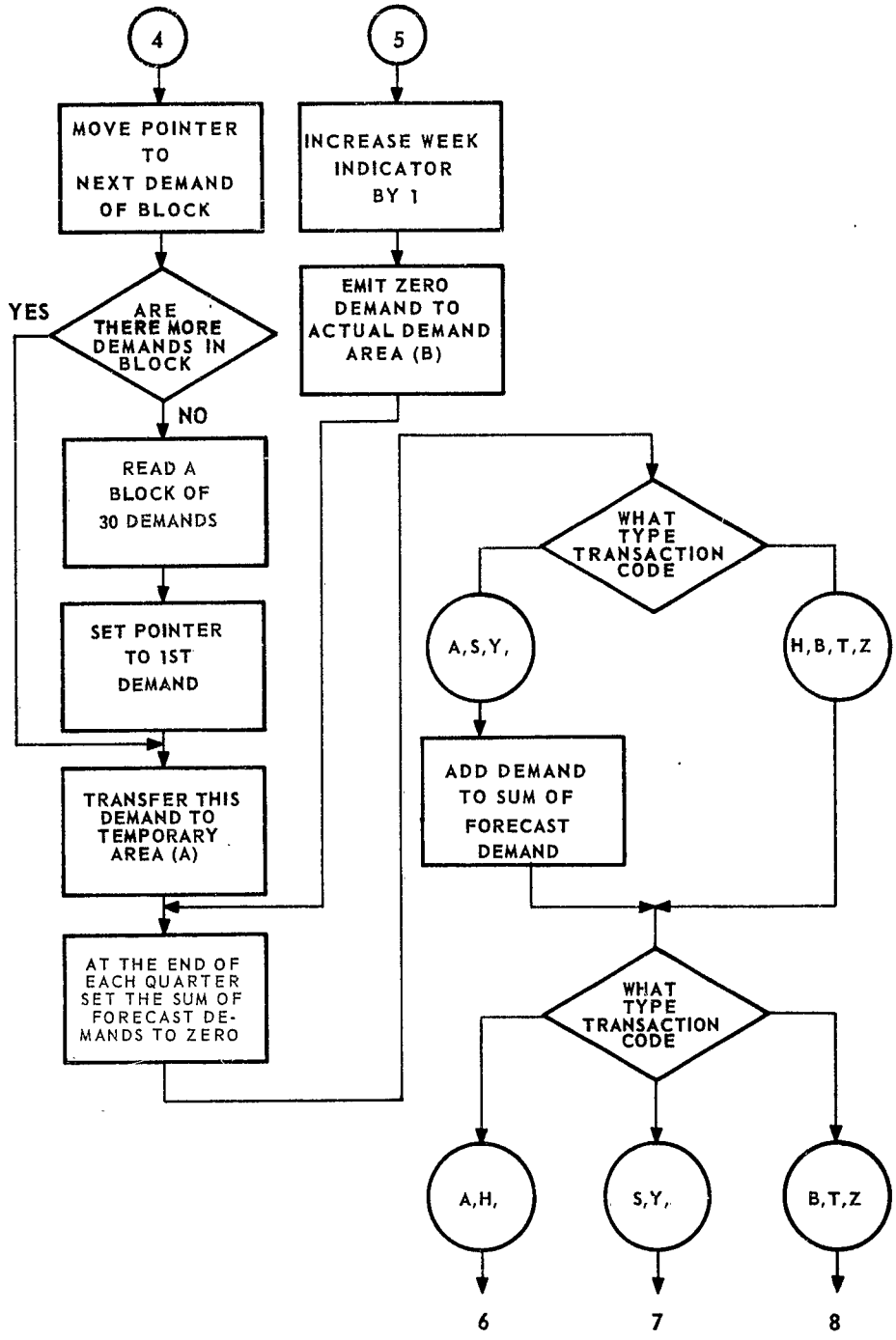
SUBROUTINE I RUN
(INITIATE RUN (SYSTEM) PARAMATERS)

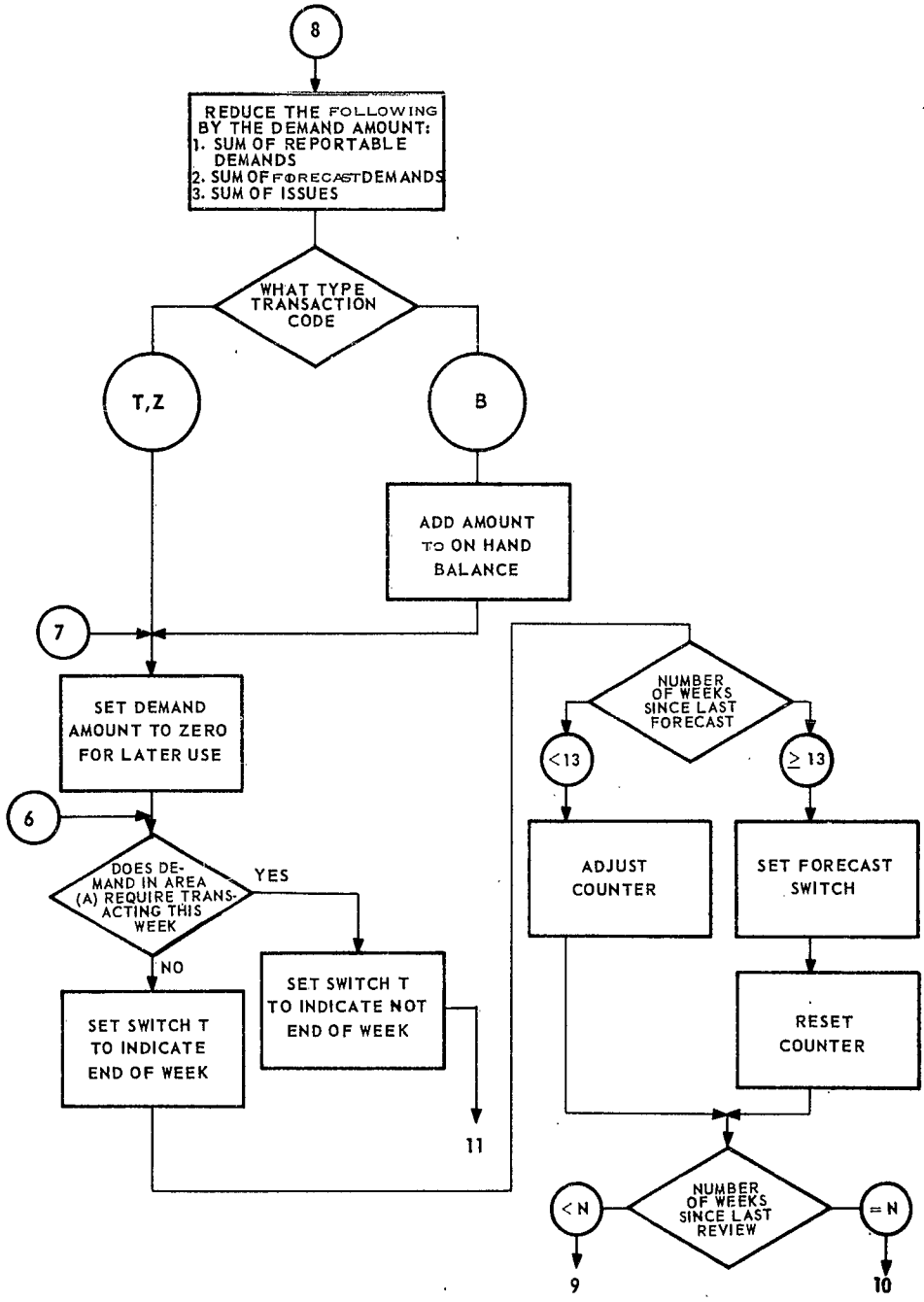


SUBROUTINE I ITEM

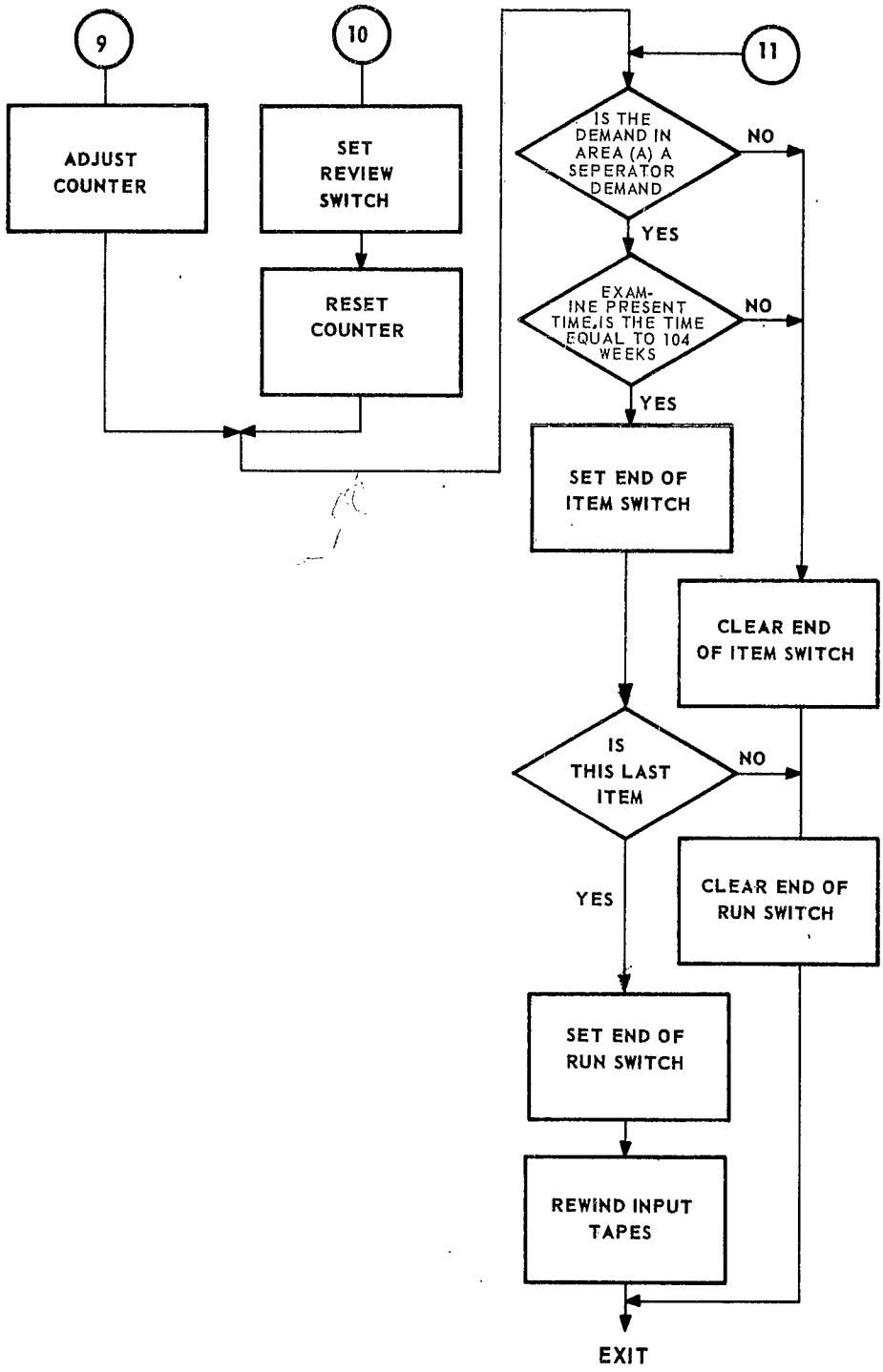



SET SWITCH B=OLD T WHERE (B) IS BEGINNING OF A WEEK AND (T) IS END OF A WEEK
IS THIS THE FIRST DEMAND OF RUN
YES
NO
IS THIS THE START OF A NEW ITEM
NO
YES
MOVE POINTER TO NEXT DEMAND IN BLOCK OF DEMAND
HAVE ALL THE DEMANDS BEEN USED IN THE BLOCK
NO
YES
READ A NEW BLOCK OF THIRTY DEMANDS
SET POINTER TO FIRST DEMAND OF BLOCK
TRANSFER THIS DEMAND TO TEMPORARY AREA (A)
IS DEMAND IN AREA (A) MORE THAN 1 WEEK IN THE FUTURE
YES
NO
MOVE DEMAND FROM AREA (A) TO ACTUAL DEMAND AREA (B)
4
5

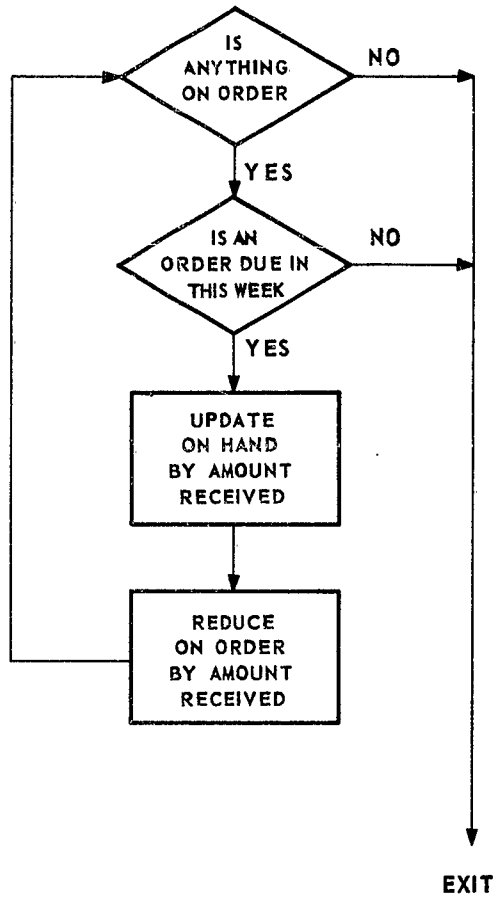

4
5
MOVE POINTER TO NEXT DEMAND OF BLOCK
INCREASE WEEK INDICATOR BY 1
ARE THERE MORE DEMANDS IN BLOCK
YES
NO
EMIT ZERO DEMAND TO ACTUAL DEMAND AREA (B)
READ A BLOCK OF 30 DEMANDS
SET POINTER TO 1ST DEMAND
TRANSFER THIS DEMAND TO TEMPORARY AREA (A)
AT THE END OF EACH QUARTER SET THE SUM OF FORECAST DEMANDS TO ZERO
WHAT TYPE TRANSACTION CODE
A,S,Y,
H,B,T,Z
ADD DEMAND TO SUM OF FORECAST DEMAND
WHAT TYPE TRANSACTION CODE
A,H,
S,Y,
B,T,Z
6
7
8

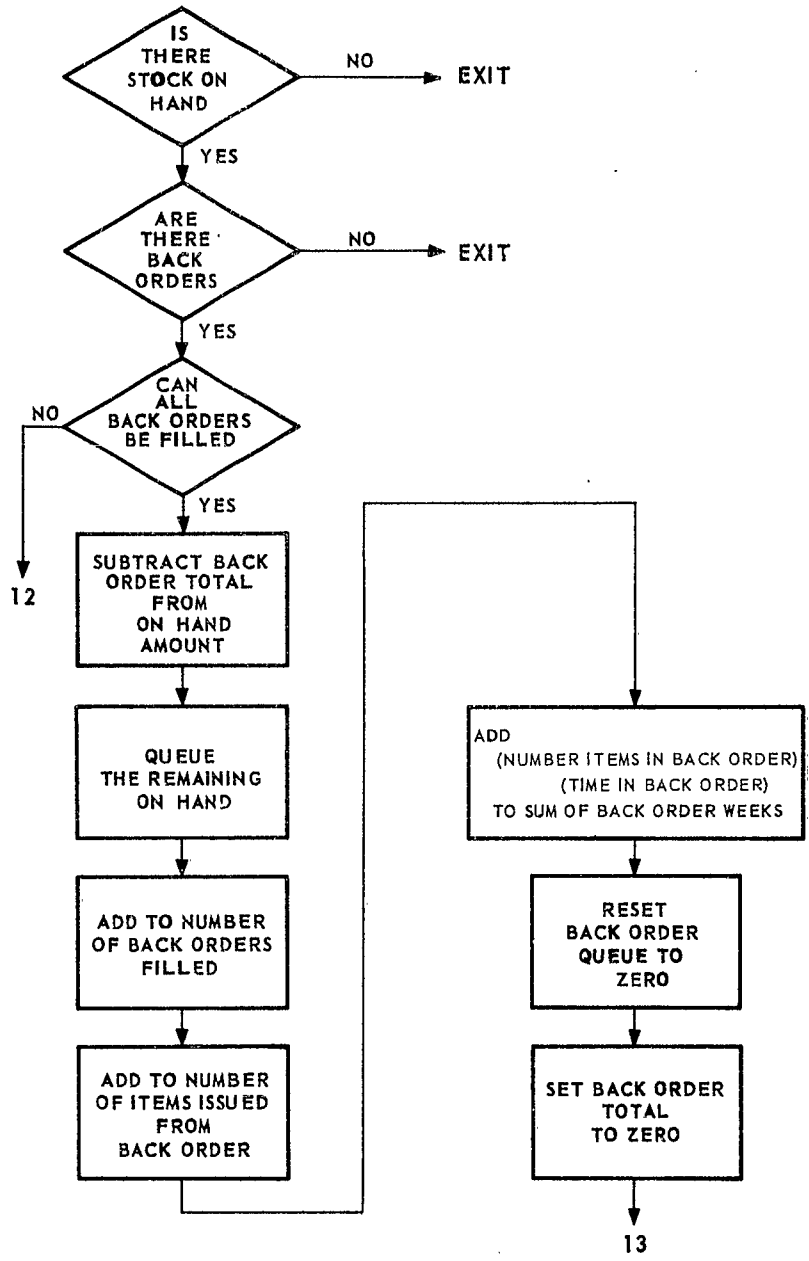

8
REDUCE THE FOLLOWING BY THE DEMAND AMOUNT:
1. SUM OF REPORTABLE DEMANDS
2. SUM OF FORECAST DEMANDS
3. SUM OF ISSUES
WHAT TYPE TRANSACTION CODE
T,Z
B
ADD AMOUNT TO ON HAND BALANCE
7
SET DEMAND AMOUNT TO ZERO FOR LATER USE
6
DOES DEMAND IN AREA (A) REQUIRE TRANSACTING THIS WEEK
YES
NO
SET SWITCH T TO INDICATE END OF WEEK
SET SWITCH T TO INDICATE NOT END OF WEEK
11
NUMBER OF WEEKS SINCE LAST FORECAST
<13
≥13
ADJUST COUNTER
SET FORECAST SWITCH
RESET COUNTER
NUMBER OF WEEKS SINCE LAST REVIEW
<N
=N
9
10

SUBROUTINE DEMAND
4 of 4

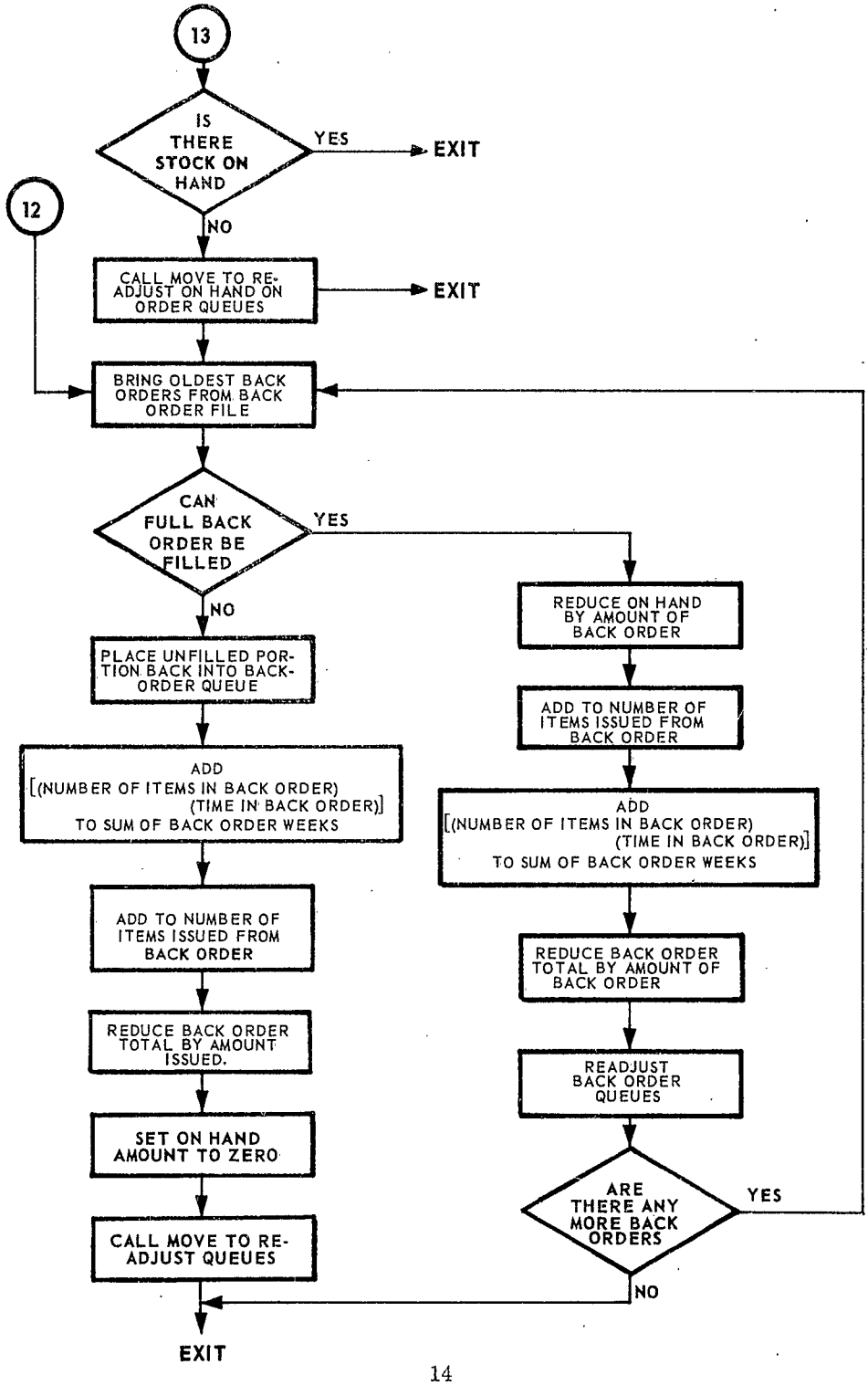


SUBROUTINE RECPT

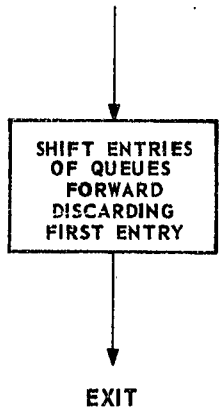


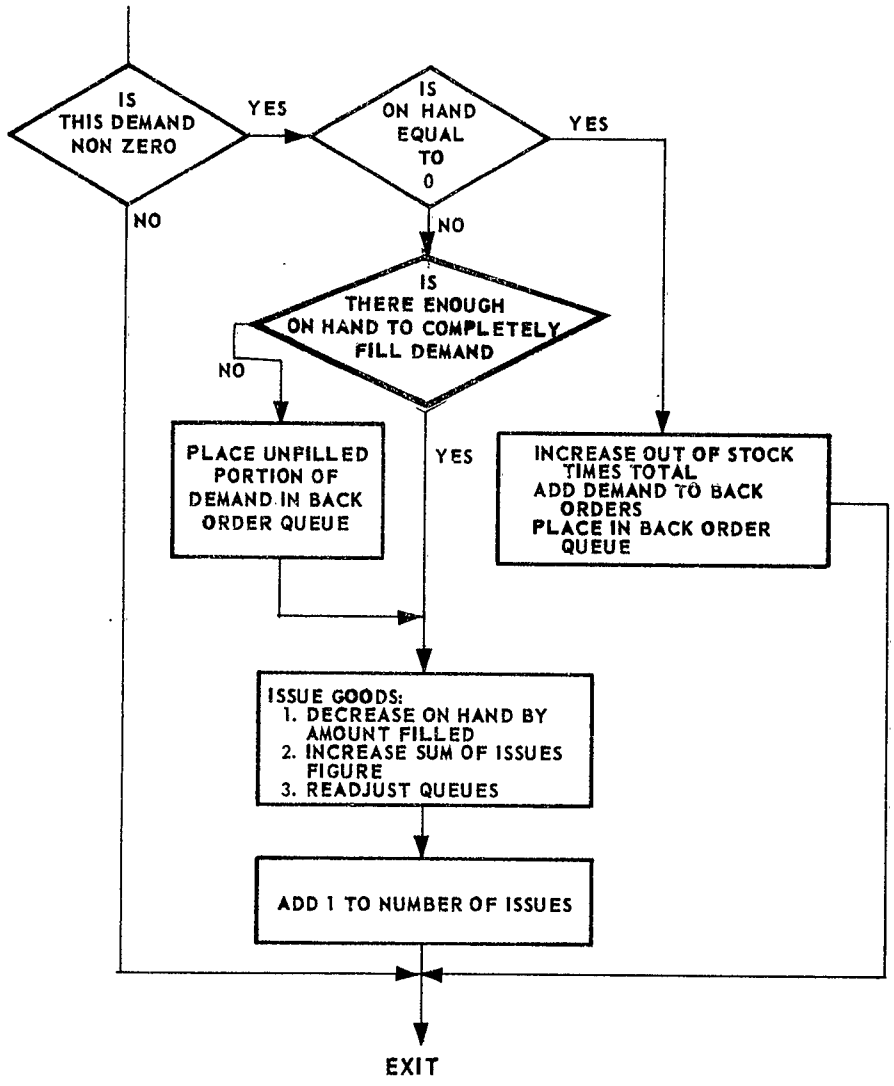

IS THERE STOCK ON HAND
NO
EXIT
YES
ARE THERE BACK ORDERS
NO
EXIT
YES
CAN ALL BACK ORDERS BE FILLED
NO
12
YES
SUBTRACT BACK ORDER TOTAL FROM ON HAND AMOUNT
QUEUE THE REMAINING ON HAND
ADD TO NUMBER OF BACK ORDERS FILLED
ADD TO NUMBER OF ITEMS ISSUED FROM BACK ORDER
ADD (NUMBER ITEMS IN BACK ORDER) (TIME IN BACK ORDER) TO SUM OF BACK ORDER WEEKS
RESET BACK ORDER QUEUE TO ZERO
SET BACK ORDER TOTAL TO ZERO
13

SUBROUTINE BOVOH
2 of 2

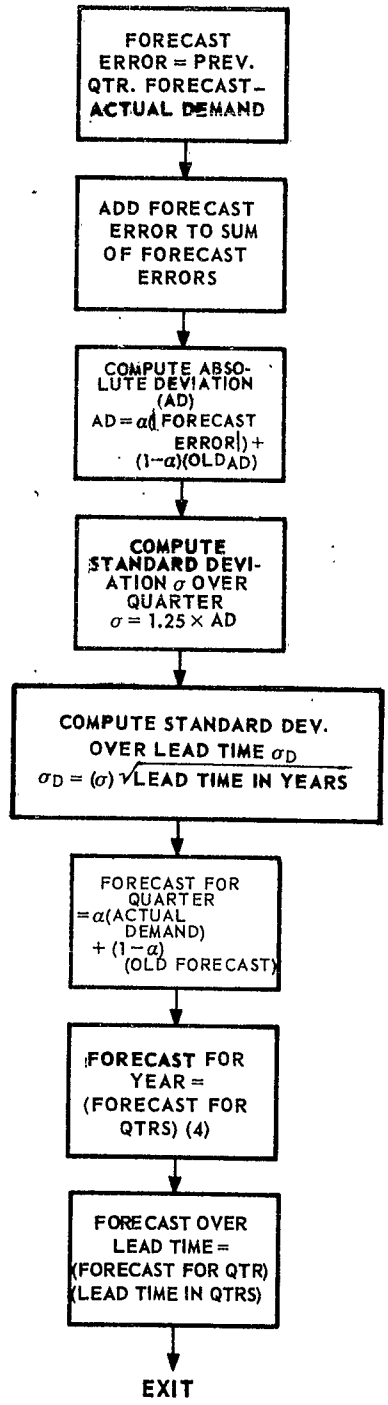


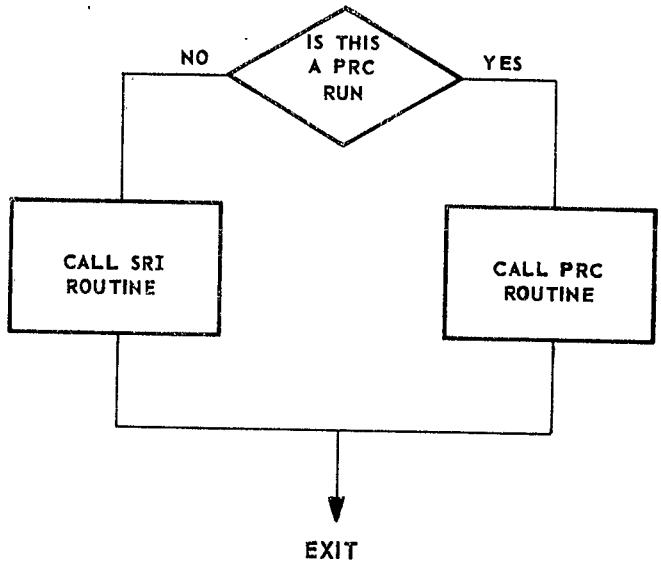
SUBROUTINE MOVE



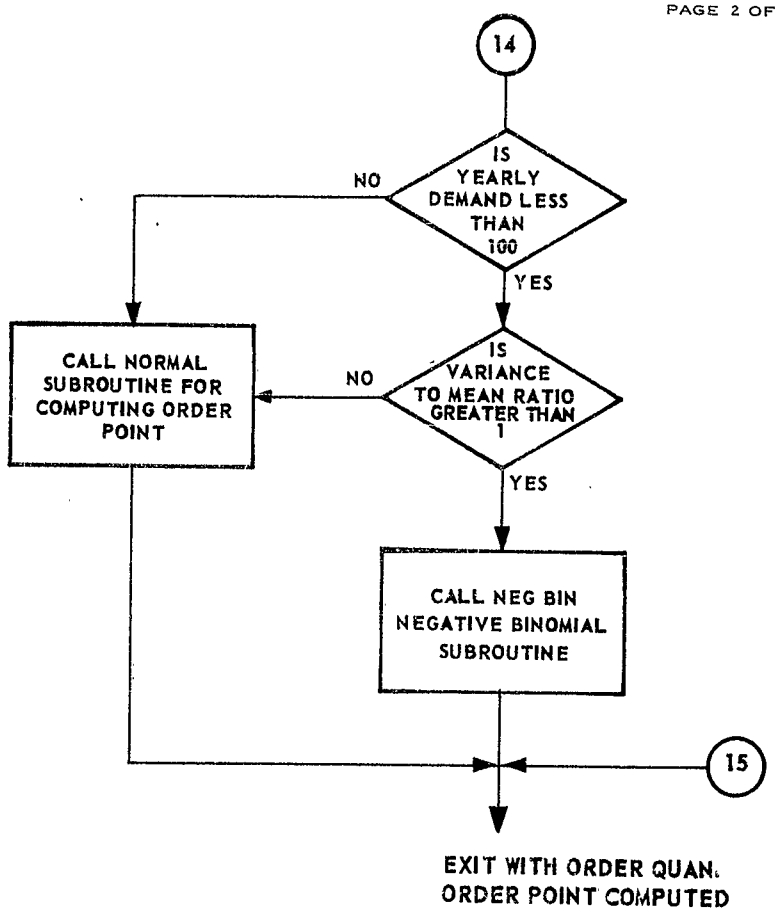

IS THIS DEMAND NON ZERO
YES
NO
IS ON HAND EQUAL TO 0
YES
NO
IS THERE ENOUGH ON HAND TO COMPLETELY FILL DEMAND
NO
YES
PLACE UNFILLED PORTION OF DEMAND IN BACK ORDER QUEUE
INCREASE OUT OF STOCK TIMES TOTAL
ADD DEMAND TO BACK ORDERS
PLACE IN BACK ORDER QUEUE
ISSUE GOODS:
1. DECREASE ON HAND BY AMOUNT FILLED
2. INCREASE SUM OF ISSUES FIGURE
3. READJUST QUEUES
ADD 1 TO NUMBER OF ISSUES
EXIT

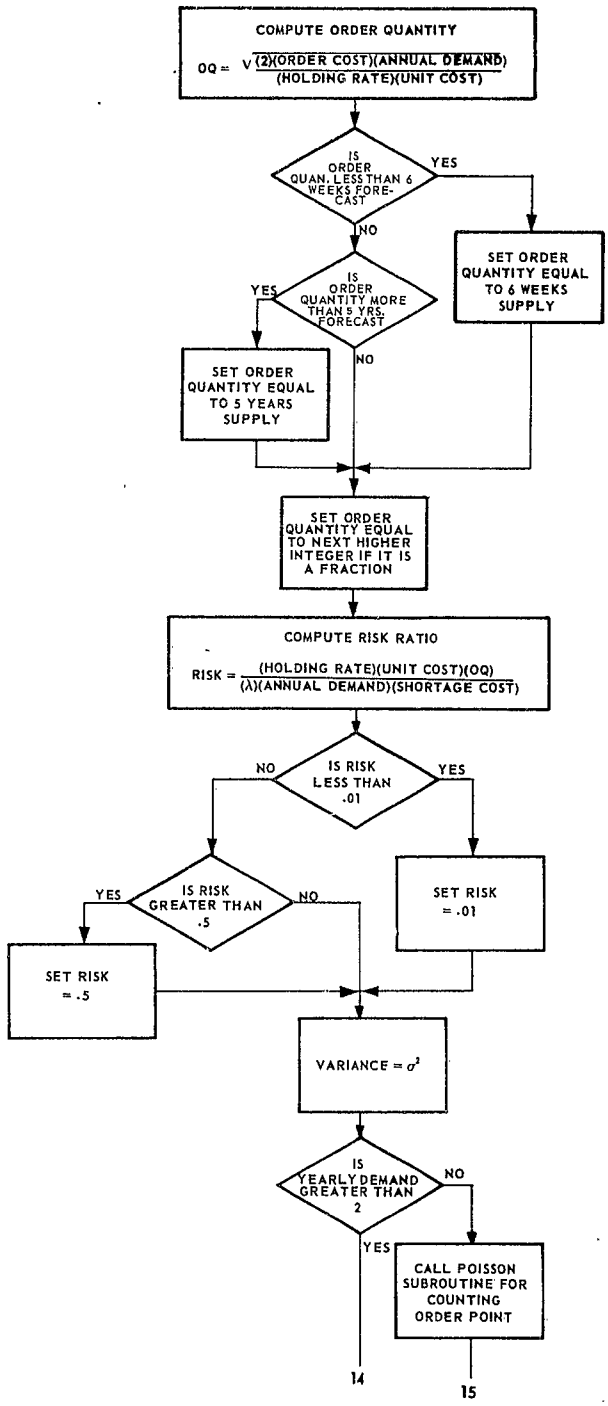
SUBROUTINE FORCST



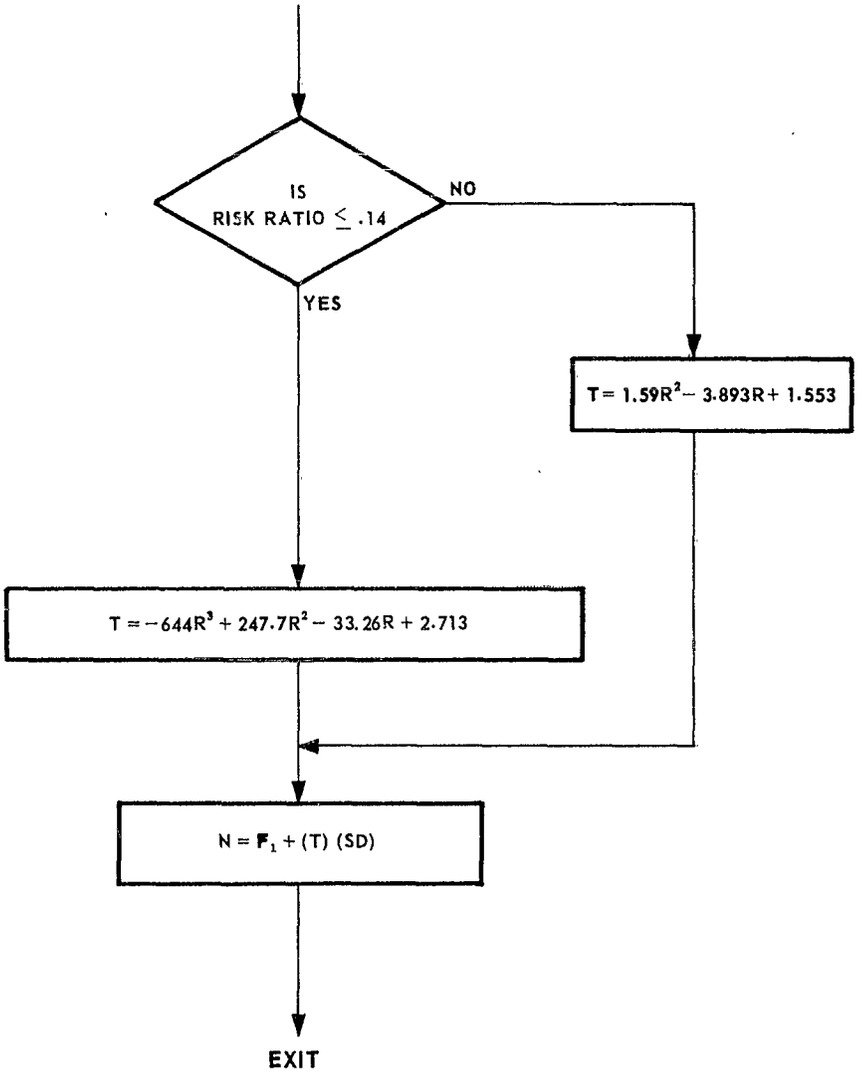

IS THIS
A PRC
RUN
NO
YES
CALL SRI
ROUTINE
CALL PRC
ROUTINE
EXIT

SUBROUTINE
PRC

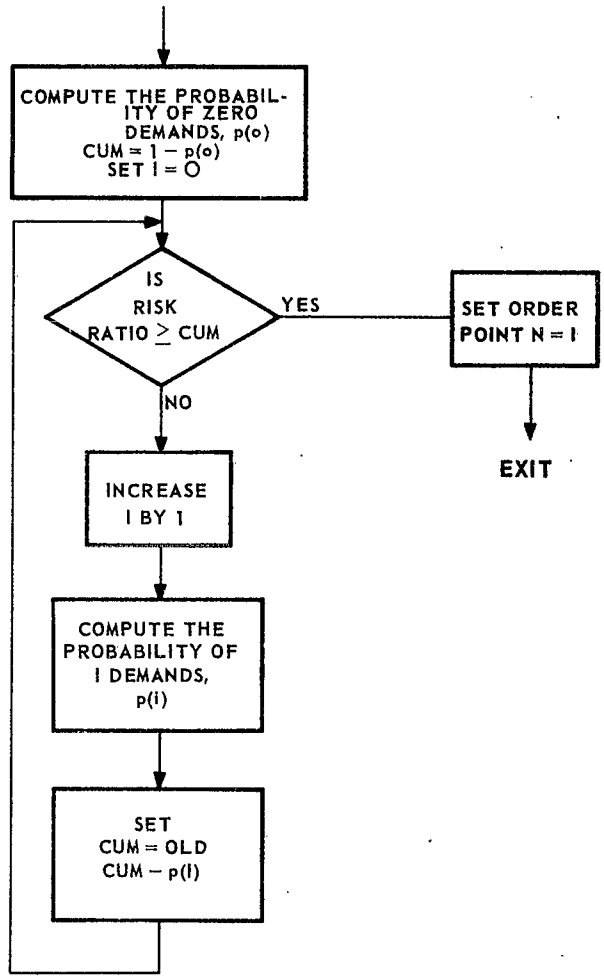



COMPUTE ORDER QUANTITY
OQ = √(2)(ORDER COST)(ANNUAL DEMAND) / (HOLDING RATE)(UNIT COST)
IS ORDER QUAN. LESS THAN 6 WEEKS FORE-CAST
YES
NO
SET ORDER QUANTITY EQUAL TO 6 WEEKS SUPPLY
IS ORDER QUANTITY MORE THAN 5 YRS. FORECAST
YES
NO
SET ORDER QUANTITY EQUAL TO 5 YEARS SUPPLY
SET ORDER QUANTITY EQUAL TO NEXT HIGHER INTEGER IF IT IS A FRACTION
COMPUTE RISK RATIO
RISK = (HOLDING RATE)(UNIT COST)(OQ) / (λ)(ANNUAL DEMAND)(SHORTAGE COST)
IS RISK LESS THAN .01
NO
YES
SET RISK = .01
IS RISK GREATER THAN .5
YES
NO
SET RISK = .5
VARIANCE = σ²
IS YEARLY DEMAND GREATER THAN 2
NO
YES
CALL POISSON SUBROUTINE FOR COUNTING ORDER POINT
14
15

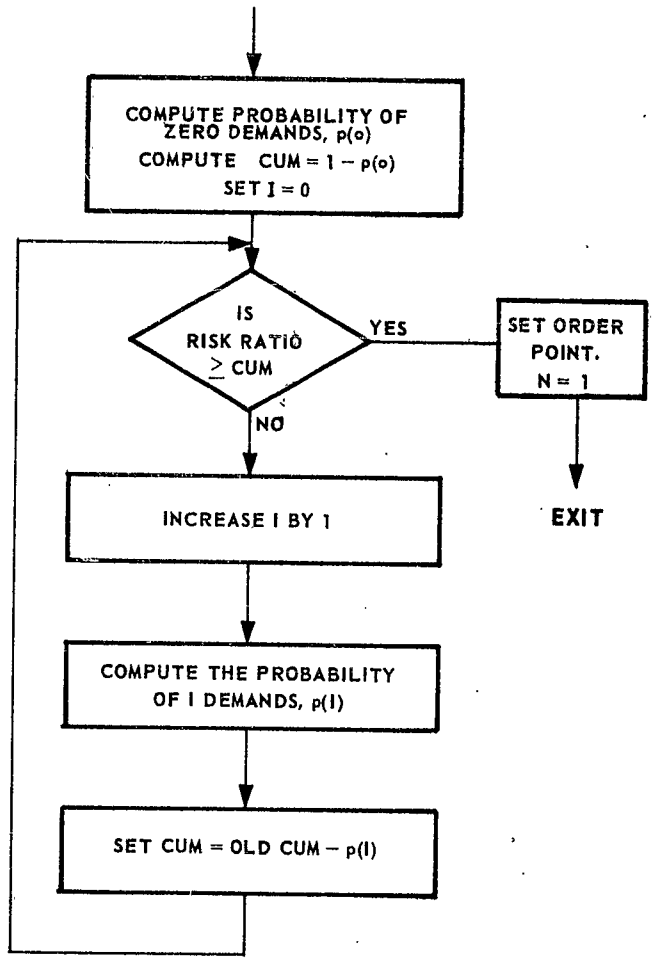
SUBROUTINE NORMAL



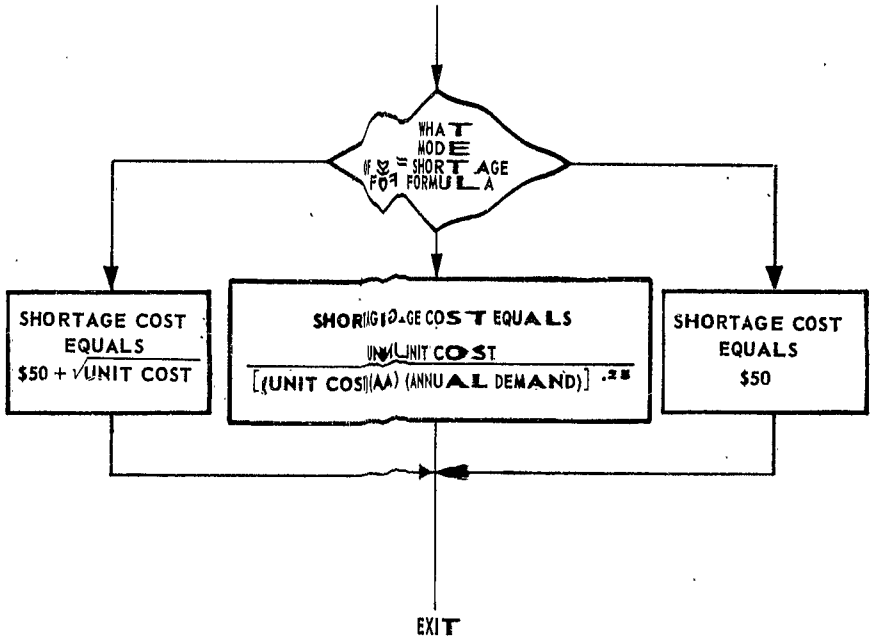
SUBROUTINE FISSON

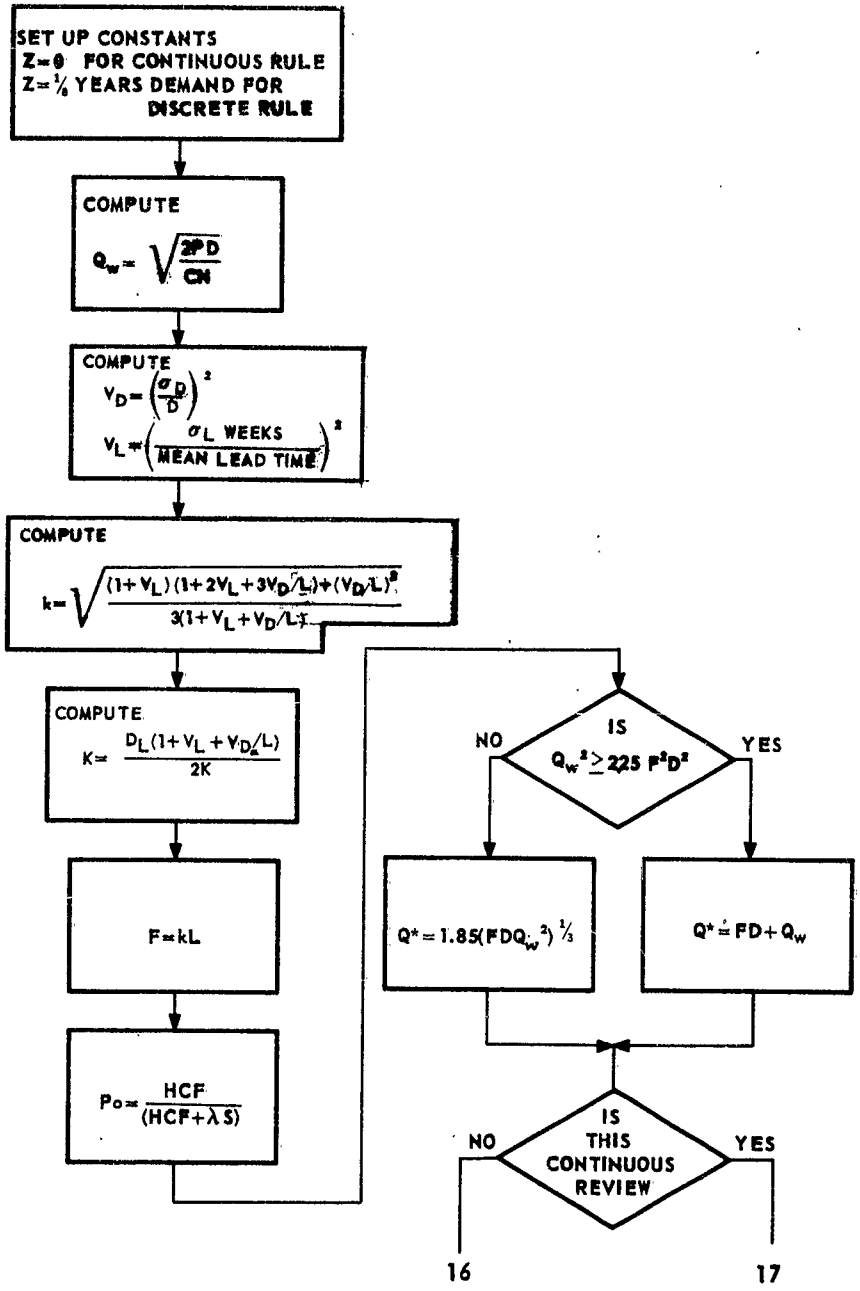


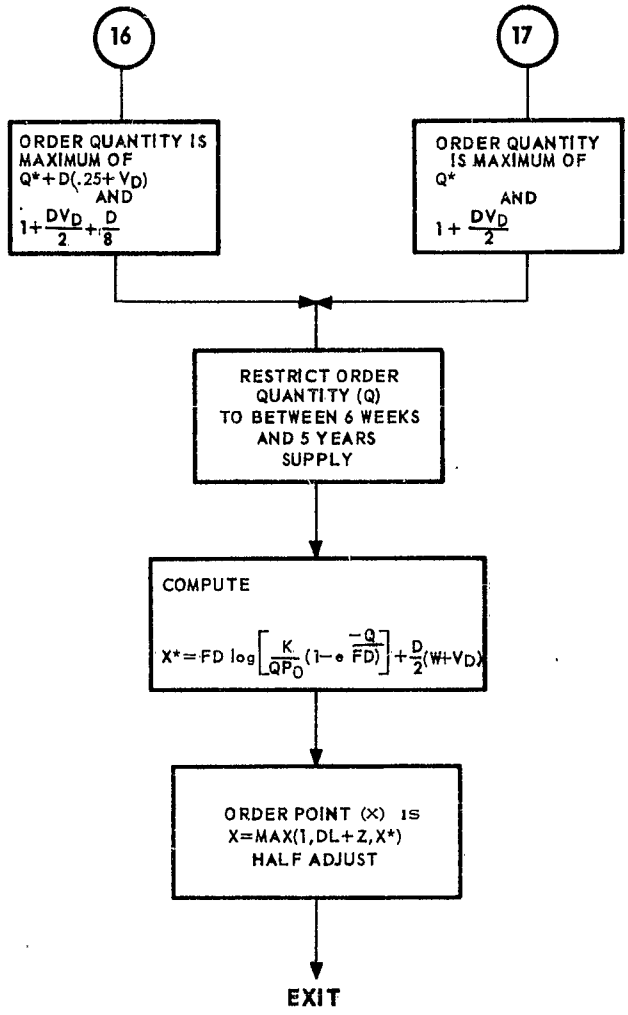
SUBROUTINE NEG BIN

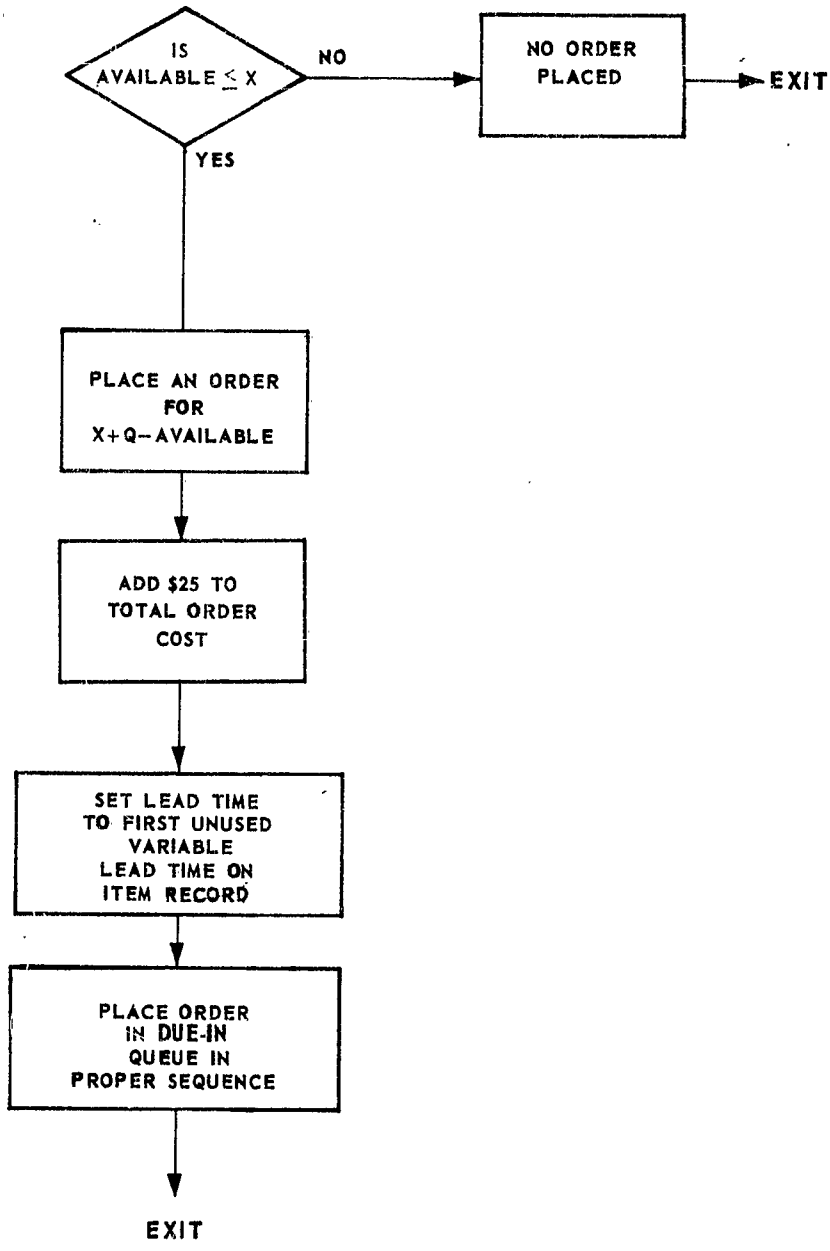


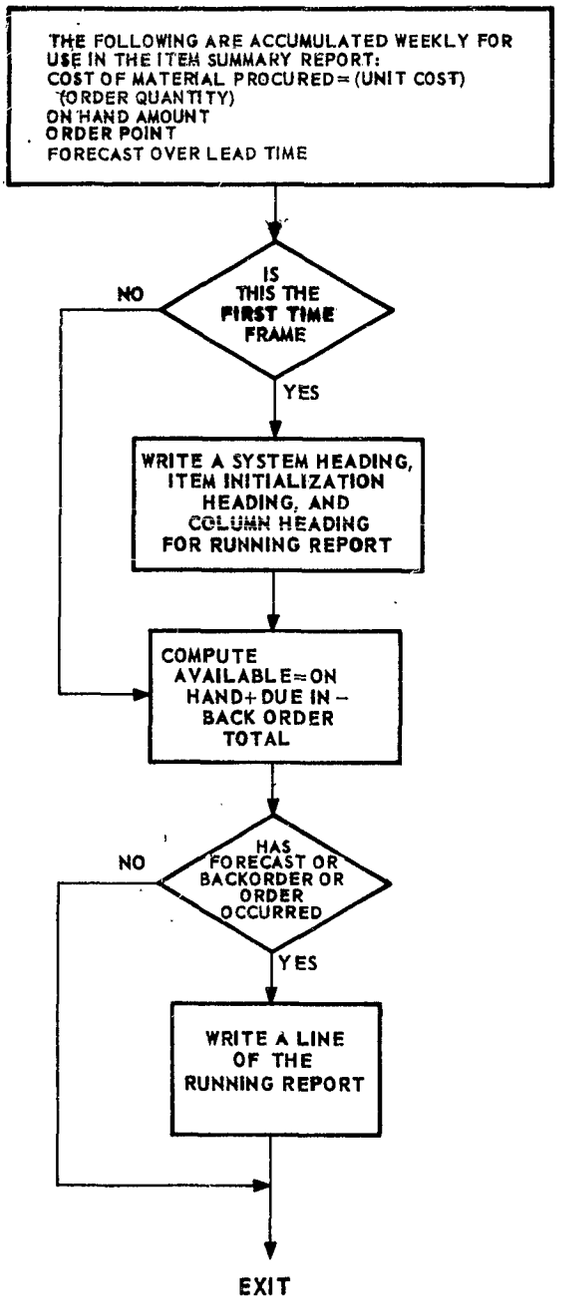
SHORTAGE COST
FUNCTION SHC(I)

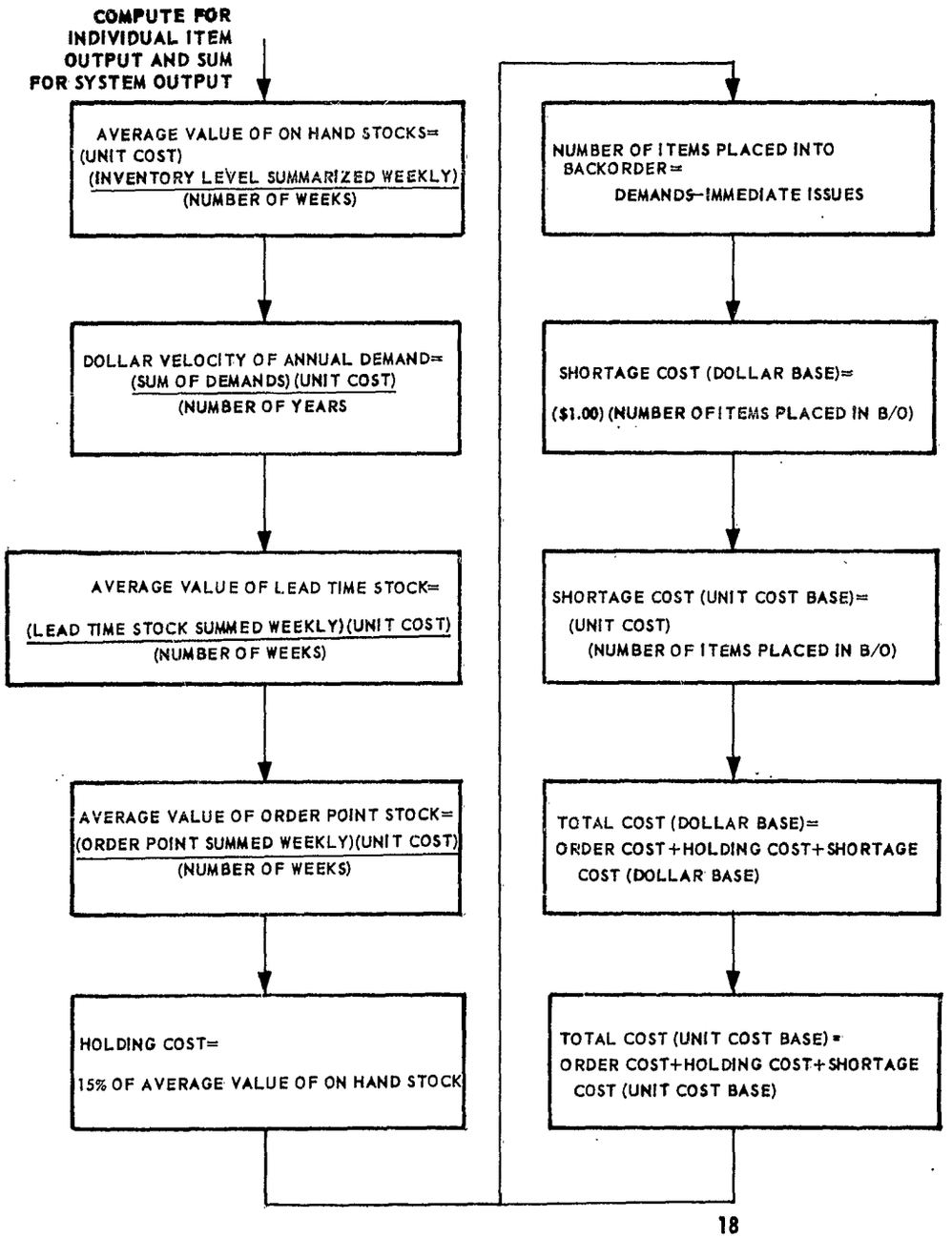


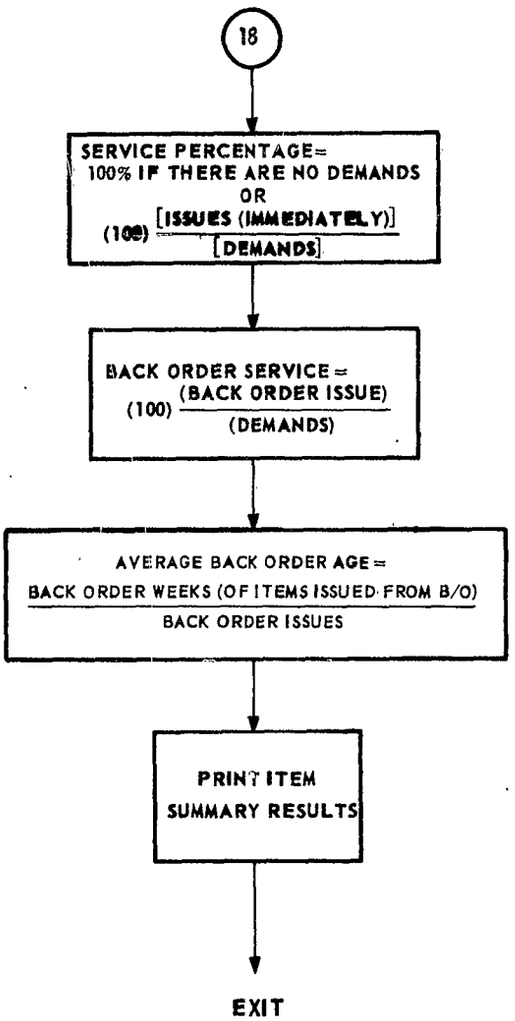
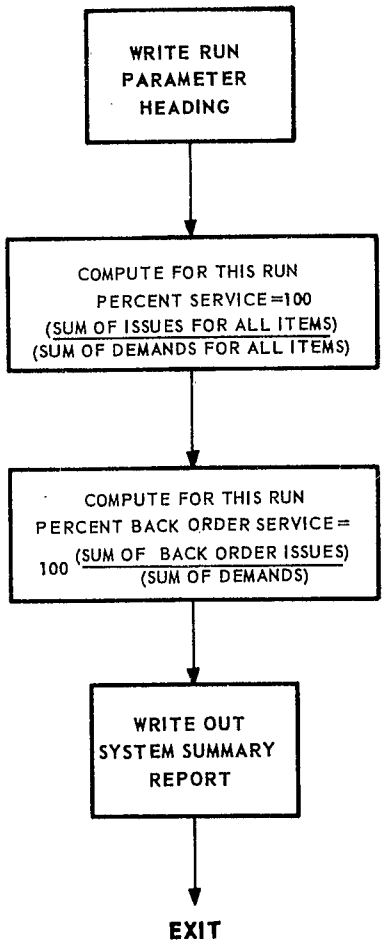

SET UP CONSTANTS
Z=0 FOR CONTINUOUS RULE
Z=1/6 YEARS DEMAND FOR DISCRETE RULE
COMPUTE
$Q_w = \sqrt{\frac{2PD}{CN}}$
COMPUTE
$V_D = \left(\frac{\sigma_D}{D}\right)^2$
$V_L = \left(\frac{\sigma_L \text{ WEEKS}}{\text{MEAN LEAD TIME}}\right)^2$
COMPUTE
$k = \sqrt{\frac{(1+V_L)(1+2V_L+3V_D/L)+(V_D/L)^2}{3(1+V_L+V_D/L)^2}}$
COMPUTE
$K = \frac{D_L(1+V_L+V_D/L)}{2K}$
F=kL
$Po = \frac{HCF}{(HCF+\lambda S)}$
IS $Q_w^2 \geq 225\ F^2D^2$
NO
YES
$Q^* = 1.85(FDQ_w^2)^{1/3}$
$Q^* = FD+Q_w$
IS THIS CONTINUOUS REVIEW
NO
YES
16
17


16
17
ORDER QUANTITY IS MAXIMUM OF
$Q^*+D(.25+V_D)$
AND
$1+\frac{DV_D}{2}+\frac{D}{8}$
ORDER QUANTITY IS MAXIMUM OF
Q^*
AND
$1+\frac{DV_D}{2}$
RESTRICT ORDER QUANTITY (Q) TO BETWEEN 6 WEEKS AND 5 YEARS SUPPLY
COMPUTE
$X^*=FD\log\left[\frac{K}{QP_0}(1-e^{\frac{-Q}{FD}})\right]+\frac{D}{2}(W+V_D)$
ORDER POINT (X) IS
X=MAX(1,DL+Z,X*)
HALF ADJUST
EXIT


IS
AVAILABLE ≤ X
NO
NO ORDER
PLACED
EXIT
YES
PLACE AN ORDER
FOR
X+Q−AVAILABLE
ADD $25 TO
TOTAL ORDER
COST
SET LEAD TIME
TO FIRST UNUSED
VARIABLE
LEAD TIME ON
ITEM RECORD
PLACE ORDER
IN DUE-IN
QUEUE IN
PROPER SEQUENCE
EXIT


THE FOLLOWING ARE ACCUMULATED WEEKLY FOR USE IN THE ITEM SUMMARY REPORT:
COST OF MATERIAL PROCURED = (UNIT COST) (ORDER QUANTITY)
ON HAND AMOUNT
ORDER POINT
FORECAST OVER LEAD TIME
IS THIS THE FIRST TIME FRAME
NO
YES
WRITE A SYSTEM HEADING, ITEM INITIALIZATION HEADING, AND COLUMN HEADING FOR RUNNING REPORT
COMPUTE AVAILABLE = ON HAND + DUE IN − BACK ORDER TOTAL
HAS FORECAST OR BACKORDER OR ORDER OCCURRED
NO
YES
WRITE A LINE OF THE RUNNING REPORT
EXIT


COMPUTE FOR INDIVIDUAL ITEM OUTPUT AND SUM FOR SYSTEM OUTPUT
AVERAGE VALUE OF ON HAND STOCKS= (UNIT COST) (INVENTORY LEVEL SUMMARIZED WEEKLY) / (NUMBER OF WEEKS)
DOLLAR VELOCITY OF ANNUAL DEMAND= (SUM OF DEMANDS) (UNIT COST) / (NUMBER OF YEARS
AVERAGE VALUE OF LEAD TIME STOCK= (LEAD TIME STOCK SUMMED WEEKLY) (UNIT COST) / (NUMBER OF WEEKS)
AVERAGE VALUE OF ORDER POINT STOCK= (ORDER POINT SUMMED WEEKLY) (UNIT COST) / (NUMBER OF WEEKS)
HOLDING COST= 15% OF AVERAGE VALUE OF ON HAND STOCK
NUMBER OF ITEMS PLACED INTO BACKORDER= DEMANDS-IMMEDIATE ISSUES
SHORTAGE COST (DOLLAR BASE)= ($1.00) (NUMBER OF ITEMS PLACED IN B/O)
SHORTAGE COST (UNIT COST BASE)= (UNIT COST) (NUMBER OF ITEMS PLACED IN B/O)
TOTAL COST (DOLLAR BASE)= ORDER COST+HOLDING COST+SHORTAGE COST (DOLLAR BASE)
TOTAL COST (UNIT COST BASE)= ORDER COST+HOLDING COST+SHORTAGE COST (UNIT COST BASE)
18


18
SERVICE PERCENTAGE=
100% IF THERE ARE NO DEMANDS
OR
(100) [ISSUES (IMMEDIATELY)] / [DEMANDS]
BACK ORDER SERVICE =
(100) (BACK ORDER ISSUE) / (DEMANDS)
AVERAGE BACK ORDER AGE =
BACK ORDER WEEKS (OF ITEMS ISSUED FROM B/O) / BACK ORDER ISSUES
PRINT ITEM
SUMMARY RESULTS
EXIT

SUBROUTINE EVRUN